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How do you solve a problem like *MaRIA*? Designing opportunities for Modelling and Reflecting on Instructional Activity within EU TAP-TS Learning & Teaching Packages and Learning Events****

Summary

The *Teacher Academy Project on Teaching Sustainability* (TAP-TS) is one of eleven inaugural Erasmus+ Teacher Academies funded to address key educational concerns of the European

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Commission in developing the European Education Area (ERA). These academies foster European partnerships to enhance cooperation among teacher education institutions, curriculum experts, and training providers in order to support teachers and strengthen their continuous professional development across Europe. TAP-TS brings together a unique consortium of European teacher education partners focused on sustainability education, creating innovative teacher-education experiences using high-quality Learning and Teaching Packages (LTPs). Central to these LTPs is a model of professional learning that is “deeply reflective” and “values-led” (Cavadas et al., 2023; Goodwin et al., 2023; Menter & Flores, 2021; Purdy et al., 2023). This paper discusses how the partnership designed and integrated opportunities for systematic and reflective teacher learning into the TAP-TS instructional activities. The paper begins with an overview of TAP-TS and notes the importance of EU *GreenComp* (Bianchi, Pisiotis, & Cabrera, 2022) in its work. It then explores the TAP-TS Design Roadmap – detailing the project’s approach to planning reflective learning experiences through resources, materials, and pedagogies. Next, it describes the TAP-TS *MaRIA* framework, which guides follow-up learning activities within TAP-TS LTPs and project learning events – illustrating how this facilitates engagement levels and reflection in both technical and professional terms. The paper concludes by discussing teacher reflection as an act of professional agency – proposing that this generative reflection extends beyond the classroom and is essential for the deeper teacher learning and professionalism pursued by TAP-TS.

Keywords: reflective professional learning, EU *GreenComp*, EU TAP-TS Teacher Academy

Introduction: Reflection and learning

Teacher reflection has long been recognised as a central and essential—if problematic and often misunderstood—aspect of teacher professional development and learning. This problematic ranges from the challenge of researching the idea empirically (Korthagen, 2010) and the need for reflection to be both *critical* and *dialogical* in terms of the cultivation of equity and social justice (Gorski & Dalton, 2020), to discussions of the deeper nature of reflection for teacher professionalism and its value within collaborative inquiry (for example: Svendsen, 2020; Goodwin, Madalińska-Michalak, & Flores, 2023).

The *Teacher Academy Project on Teaching Sustainability* (TAP-TS) is one of eleven inaugural Erasmus+ Teacher Academies funded to address key educational concerns of the European Commission in developing the European Education Area (ERA). These academies foster European partnerships to enhance cooperation among teacher education institutions, curriculum experts, and training providers, in order to support teachers and strengthen continuous professional development. TAP-TS brings together a unique, interdisciplinary consortium of European teacher education partners focused on sustainability education to design, develop, and disseminate innovative teacher-education experiences built around high-quality Learning and Teaching Packages (LTPs). Central to these LTPs is a model of professional learning that is “deeply reflective” and “values-led” (Cavadas, Branco,

Colaço, & Linhares, 2023; Goodwin et al., 2023; Menter & Flores, 2021; Purdy, Hall, Khanolainen, & Galvin, 2023). We have come to see this approach as generative, dialogical, and essentialising. Placing opportunities for such systematic, reflective teacher learning at the heart of TAP-TS LTPs emphasises the central role of what we envision as *generative reflection* in the TAP-TS vision for teacher professional learning and development.

The professionalising value of purposive reflection is well-articulated by Flores (2023) when she notes the need to move beyond “...a narrow and simplistic view of teaching and of the process of learning to teach” in order to cultivate dispositions, attitudes, and beliefs that are essential to mastering the “sophisticated, contextual and dynamic nature of teaching” (p. 557). Teacher reflection in this view foregrounds the potential that taking a generative approach holds for criticality, agency, and identity: this is a *leitmotif* of TAP-TS LTPs.

Two observations directly relevant to this present paper follow from this. First, within the TAP-TS project *generative reflection* is envisioned as an essential activity for teacher learning in a postdigital world. It enables educators to adapt to technological changes (Guggemos & Seufert, 2021), engage more meaningfully in critical thinking and innovation (Hauerwas, Gomez-Barreto & Fernández, 2023), enhance their professional development through purposive activity (Svendsen, 2020), build resilience and adaptability (Galvin et al., 2023), and encourage collaborative as well as individualised learning (Segal, 2024). But primarily, this premises life-course agency and agentic action (Eteläpelto, Vähäsantanen, Hökkä, & Paloniemi, 2013). By embracing dynamic and continuous generative reflective practices, teachers can more effectively and more confidently navigate the complexities of contemporary education and prompt meaningful improvements in teaching and learning experiences.

Second, the interdisciplinary nature of the TAP-TS project team brought some interesting and rather different perspectives to project conversations on the nature and practicalities of reflecting for learning. This included perspectives and approaches from Human-Computer Interaction (HCI) and visual arts methodologies that were unfamiliar in the teacher education context and its discourse – in particular the notions of generative reflection stages (Jung & Trischler, 2021) and HCI design resources that support reflection (Bentvelzen, Woźniak, Herbes, Stefanidi, & Niess, 2022). Insights from these conversations enabled the LTP architects and writers to embed additional intention and purpose into the project designs – so creating extended opportunities for generative reflection within project learning materials and events. Designing in this richer way resulted in LTPs that better enabled professional learning and critical engagement. Consequently, TAP-TS LTPs incorporating these stages and design resources offer a more continuous, dynamic learning process which prompts learners to engage deeply with their experiences,

insights, and so encourages pedagogical action that fosters growth, teacher agency, and innovative thinking. This helps project participants to cultivate those essential 21st century educational dispositions, attitudes, and beliefs that Flores (2023) references. Of course, reconciling and leveraging the variety of perspectives and interests that partners brought to the work was not always straightforward or without challenges to the project's implementation. The co-authoring of all substantive elements of the project went a considerable distance towards mitigating this, as did the practices of frank and open discussion which came to characterise TAP-TS regular Project Steering Group (PSG) meetings and the ad-hoc planning to do with individual events and LTP development. For instance, all LTPs were co-authored and the resources co-developed by pairs or groups of partners and each project learning event was assembled by more than one partner – most having contributions from across the project consortium in terms of both planning and delivery. From the experience of the project, we would argue that collaboration, co-authoring, and co-design are crucial in multi-partner professional development projects, as they leverage diverse expertise, foster shared ownership, and provide better opportunity for creativity. By integrating the varied perspectives brought by TAP-TS partners, we found that these practices lead to more inclusive and innovative solutions while building better understanding and strengthening relationships among partners. This helped ensure alignment with the project goals, more efficient use of our resources, and contributed in a major way to scalable, sustainable outcomes. Additionally, working in this mode promoted adaptability, broadened the range of outputs, and amplified the project's impact by helping build robust communication, mutual accountability, and strength-centred design. Together, they created a foundation for achieving meaningful, enduring success for our project. A subsequent paper will expand on this and share project learning around the value deliberative co-creation brought to TAP-Ts and similar Erasmus+ Teacher Academies.

The paper is structured as an account of our experiences designing-for and building-in opportunities for systematic, generatively reflective and dialogical teacher learning within TAP-TS project actions and resources. It represents part of the project team's ongoing collective attention to articulating and sharing the learning that emerged through designing, developing, in-context testing, and user validation the TAP-TS LTPs as key project outputs.

The preceding introduction to the background, professionalising intentions, and developmental nature of the TAP-TS project is followed below by detailing of the co-design and co-development methodology the project team adopted, an illustrative discussion of the development and incorporation of what is termed the TAP-TS *MaRIA* framework into post-activity reflection for learning, and a discussion

of the design-learning that we found resulted from pursuing the uniquely generative nature of project materials and activities.

In brief: the discussion below opens with a description of the project's initial planning phase and the emergence of the project's design roadmap, including an exploration of how opportunities for reflection were systematically written-into the activities promoted in the project LTPs. Following this, there is a discussion of the further opportunities for reflection systematically included in TAP-TS learning events and added post-piloting to the concluding/continuation aspects of the LTPs. This is termed the TAP-TS *MaRIA* framework. This discussion addresses how the project tackled the challenge of instantiating occasions for reflecting meaningfully during opportunities provided for Modelling and Reflecting on Instructional Activity – within project learning events and LTPs. In the closing sections of the paper an assessment is offered of the value of the TAP-TS approach – including indications of work remaining to be done and discussions of progress to date set against leads taken from the notions of generative reflection stages (Jung & Trischler, 2021) and what has been achieved in terms of HCI design resources that support reflection (Bentvelzen et al., 2022), as mentioned above.

Defining and building the TAP-TS LTPs – explorations in designing for quality in learning

What is a TAP-TS LTP?

The TAP-TS Learning and Teaching Packages (LTPs) are in essence Learning and Teaching Programmes that include sets of open and flexible learning and teacher materials as well as curated proposals on how these might be used, co-developed and validated by the TAP-TS Partnership. Firstly, the LTPs are planned as formalised modules that can be taken and freely adopted/adapted by teacher education institutions across the EU. Secondly, they include materials and resources for teachers to directly implement in their classrooms, with needed adaptations. The core purpose of the LTPs is to motivate, build confidence, and provide teacher educators, teachers, and student teachers with high-quality materials, ideas, and other practical support on educating for a greener, more sustainable Europe. These materials have formed the foundations for the TAP-TS Academy activity over the life of the project. Importantly, within the TAP-TS activities, learning goes beyond theoretical knowledge acquisition, incorporating practical elements and leveraging participants' personal experiences. Reflection is a key aspect, deepening the learning process and fostering personal development. Thus, in this section, we present the initial design stages of what we call Learning and Teaching Packages (LTPs), and

the process of incorporation of the EU *GreenComp* Framework to the development work of the project. We describe the TAP-TS Roadmap and Architecture; and how we systematically build opportunities for reflection into the activities promoted in the project LTPs.

The design process started with the development of an LTP architecture, along with a unique, interdisciplinary Design Roadmap based in the project specifications and the overarching purposes of the Erasmus+ TAP-TS Academy as devised originally by the lead-team at TU Dresden and UCD, Dublin. This was led by University College of Teacher Education, Vienna (PHW) and Technical University, Darmstadt (TU Darmstadt) who took on the role of guiding and assisting project colleagues in this initial and foundational work. The principal challenge was to develop flexible “programmes” that could be adopted by teachers and teacher educators with diverse experiences, backgrounds, and levels of prior knowledge, and that could be used in diverse contexts regardless of disciplines but with a focus on developing “sustainability” values, interdisciplinary knowledge and understandings. These to include cognitive skills, key transferable skills, and practical interdisciplinary skills, linked to and going beyond the EU *GreenComp* framework. In fact, the LTPs are designed as incentives for educators to engage with various aspects of sustainability education, to be adapted and further developed by teachers in relation to their contexts of practice. Interdisciplinarity is seen as profoundly important to achieve a holistic understanding and address complex sustainability issues. As suggested in the literature, interdisciplinary learning for sustainability is needed to enable students to look for relationships, interactions, and one of the key principles for the LTPs Architecture.

In general terms, the TAP-TS LTP architecture follows a rather straightforward line. Each LTP consists of related units with a particular content focus, suggestions for teaching and learning activities for teachers (student teachers) and students, along with a selection of curated resources and support materials emphasising curriculum connections. These reference *GreenComp* competence area(s) and the unit closes with suggestions for relevant assessment and reflective follow-through on the entire experience. Each unit is organised into four phases: Start-Up, Development, Consolidation, and Follow-Up activities. A key characteristic of the LTPs is their focus on **activity-based learning**. They are built around creating tasks, situations, project work, activities, and other pedagogically powerful ways to develop the related *GreenComp* competences and reach the set learning objectives. Following a constructivist philosophy – particularly the work of Piaget, Dewey, and Vygotsky – LTP-led learning is an active process in which seeking knowledge is based on personal experiences and interactions with the environment. LTP activities, frequently unfold in terms of different active learning pedagogies leading to

a variety of learning and assessment approaches that support the purposes/aims of the unit and the package in general. TAP-TS Learning Events – online workshops, active learning events and summer academies – make use of this LTP-led flexibility and so offered different learning formats and experiences within the overall frame of the TAP-TS project.

In brief: the TAP-TS design roadmap is seen as a pedagogical and didactic guidebook. It models and prompts the steps taken when developing an LTP, and which can of course also be applied by teachers when developing additional/ supplementary materials for teaching sustainability. Schematically, the Roadmap is presented in terms of six flexible steps (areas of attention) for consideration during the production of the LTP (see Figure 1, which is included for illustrative purposes). The content of each area/step is built on key design principles and a number of carefully selected pedagogical approaches for teaching sustainability. These are informed by current research and leading-edge practice in Education for Sustainability (EfS) and are generally framed around relevant elements of the EU *GreenComp* Framework (Bianchi et al., 2022).

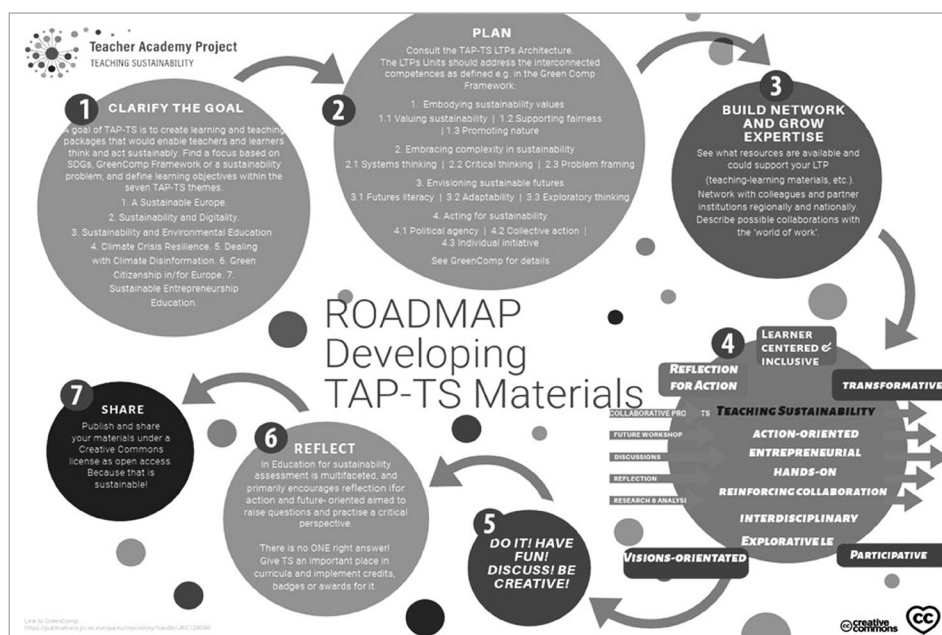


Figure 1. TAP-TS Roadmap for designing Learning and Teaching Materials.

In the Table below (Table 1), we explain the Roadmap and its steps in detail to illustrate something of this engagement with both research and EfS principles.

Table 1. The TAP-TS Design Roadmap: the steps/areas of attention in the TAP-TS LTP Design Journey

1. CLARIFY THE GOAL	The overarching goal of an LTP is to enable and encourage learners and teachers to think and act sustainably. To actively participate in the discourse on sustainability, the topics must also be addressed – sustainably – in schools and universities. The goal of TAP-TS is to create learning and teaching packages for this purpose in the following areas: 1. A Sustainable Europe; 2. Sustainability and Digitality; 3. Sustainability and Environmental Education; 4. Climate Crisis Resilience; 5. Dealing with Climate Disinformation; 6. Green Citizenship in/for Europe; 7. Sustainable Entrepreneurship Education.
2. COMPETENCY AREAS	The LTPs should be aligned with the interconnected four competence areas defined in the <i>GreenComp</i> Framework: • Embodying sustainability values; • Embracing complexity in sustainability; • Envisioning sustainable futures; • Acting for sustainability. Each activity should be aimed to target a number of competences presented in the framework and connect to a set of learning outcomes for each LTP unit.
3. NETWORKING & BUNDLE EXPERTISE	There are many exciting topics. 1. Find a focus: what driving question is at the centre. 2. See what resources are available (competencies, teaching-learning materials, etc.). 3. Network with colleagues and partner institutions; locally, regionally, and nationally.
4. WORKING THROUGH THE DESIGN PROCESS	Teaching Sustainability (TS) should be: interdisciplinary, participatory and democratic approaches, action-oriented; mindset changing; hands-on, focusing on real life challenges; stimulating creative collaboration between teachers and learners; visions-oriented; and of course reflective. Approaches to teaching sustainability may be inquiry-based learning; explorative learning; networked learning; participation learning aimed at problem framing. Teaching Sustainability may incorporate the following activities: collaborative projects, future framing workshops, research and analysis, discussion, and reflection.
5. REFLECTION & ASSESSMENT DESIGN	In TS assessment can be multifaceted and primarily encourage reflection for action and future-oriented thinking. There is not always ONE right answer. The goal should be to RAISE QUESTIONS. TS is not about teaching the “right” behaviour, but about practising a critical perspective. Give TS an important place in curricula and implement credits, badges, or awards for it. It is important to reflect not only on the experiences but also on what action can be taken or requested to maintain and restore ecosystems and enhance justice. Reflection to construct a vision for a more sustainable future is what guides the follow-up activity of each LTP Unit.
6. PUBLISH TO TAP-TS PLATFORM	Share and publish your materials under a Creative Commons licence as free as possible. Because that is sustainable!

TAP-TS LTPs as engagements with a desired future

Education for Sustainability aims for students to acquire knowledge regarding sustainable development and a strong understanding of issues regarding their environmental, social, and economic dimensions (Rieckmann, 2018). Furthermore, EfS strives for individual and collective transformation in the form of fostering attitudes and behaviours towards sustainability and just transition to a more equitable and sustainable future. In order to achieve this, (key) competencies for sustainability and sustainable development have been described in the literature (see for example: Bertschy, Künzli, & Lehmann, 2018; Rauch & Steiner, 2013; Sleurs, 2008, Wiek, Withycombe, & Redman, 2011), as well as in key policies, initiatives and documents from the United Nations Educational, Scientific, and Cultural Organisation (Rieckmann, 2018).

TAP-TS as a project and an interdisciplinary partnership for meaningful change in educating for sustainability, works with the lessons of these and many similar initiatives – past and present. However, from the outset the partnership has found particular value in the comprehensive and accessible nature of the EU *GreenComp* framework (Bianchi et al., 2022). This is a recently developed competence framework from the Joint Research Centre of the European Commission and is designed to guide understandings and practices for sustainability as a competence among learners of all ages and across all types and levels of education – formal, non-formal, and informal – along with their educators. *GreenComp* offers a surprisingly adaptable framework to help specify the structure, content, and key competencies essential for fostering more sustainable thinking and action and so advance the sustainable development of society. A key attribute of the framework is that it is conceived as a “living document”, implying a dynamic and adaptable nature which allows for flexible adoption in diverse contexts (Bianchi et al., 2022). This has been one of the motivations for the project to adapt *GreenComp* as a central building block for project activities and outputs of TAP-TS. Its adaptability allowed the project partners to use the Framework as a guidance document for co-designing the materials that foster sustainability competences, and developing a shared understanding of specific competences, knowledge areas and skills necessary to address sustainability challenges. Meaningfulness of educational material for teachers and educational practice is seen as important in defining the key themes and clarifying the goals for LTPs. The competences included in *GreenComp* were used extensively during the initial design phase when the project partners discussed and decided about the content and activities of the LTPs units and project learning events. Furthermore, the specific ideals embedded in its four areas of attention were used in the development of the project self-assessment questionnaires and follow-up activities to construct the reflective approaches that we will discuss in the next

section. Consequently, *GreenComp* has been fundamental to the nature of TAP-TS LTPs and by extension to its learning events and activities.

TAP-TS LTPs as collaborative engines

As a result of collaborative work, the materials of LTPs are designed in such a way that they connect the abstract sustainability competencies defined in the *GreenComp* framework with challenging and yet practical classroom activities and resources. They are essentially engines for collaboration and meaningful learning. Our hope was and is that the development of the TAP-TS LTPs would give educators and students access to valuable resources to promote sustainability and drive positive change in learners' actions and mindsets. While the *GreenComp* guides our work in the competence area, the content and nature of the activities is directed by the current research and the partners expertise in the field.

At the beginning of the development process, we attempted especially to answer the following questions:

1. What are the most pressing issues/themes that offer content related to education for sustainability and happenings around the globe that should be important for teachers, children, parents? (Climate change, resources management i.e., food, water, democracy and digitalisation, justice and human rights?)
2. What are the concepts and values that cross these themes and form the essence of sustainability? (i.e., human rights, respect for diversity, social justice and democracy, inclusion etc.). Content of the LTPs materials is then structured around concepts and values having in mind the *GreenComp* but also having an in-depth understanding of the goals of teacher education. Thus, the process assists both the clarification of goals for planning the educational materials for as well as the interconnectedness of educational materials while at the same time allowing for the autonomous construction of different "modules" of sustainable education for teachers.
3. How can these concepts and values acquire meaning in teachers' everyday lives as professionals and as individuals? How can we transform goals and content of sustainable education to Teacher Education processes (content knowledge and pedagogical content knowledge)?

These questions were addressed with the help of the key principles suggested in the TAP-TS Roadmap: interdisciplinarity, designed-in relevance, authenticity, hands-on emphasis, intrinsically valuable materials that nurture both learning and play while dealing with complex sustainability issues; emphasise on the need to raise awareness of sustainability challenges; the promotion of individual and col-

lective action-oriented reflection; emphasis on the role of empathy in designing engaging learning experiences and increasing awareness of our human impacts on the environment and society; and wherever possible the fostering of collaboration, community and belonging in teaching sustainability.

The value of disinterest: the role of impartial and expert advice in TAP-TS

An important stage in the project initiation was the establishment of the TAP-TS Project Advisory Group (PAG). The PAG was charged with ensuring that project activities, deliverables and outputs met the requirements of a project on this scale and ambition, while remaining disengaged from its direct work and day-to-day activities. Essentially, offering supportive yet challenging feedback on the nature and detail of project resources, activities and plans. The Group includes experts in the fields of education for sustainability, learning design and implementation, monitoring and assessment, and general didactics. The composition of the PAG shifted as the project progressed but the group has consistently played an invaluable role in guiding and informing our work, beyond the initial phase. In particular, valuable guidance has been given in terms of the pedagogy of sustainability with PAG members – individually and collectively – offering suggestions and even specific examples of how TAP-TS resources could be better integrated into existing European curricula/assessment frameworks, and on approaches to engaging participants in considering their own community contexts and using this as a starting point for accessing the global issues. While largely unfamiliar initially with the *GreenComp* framework, the TAP-TS PAG came quickly to see its affordances and consequently were in a position to offer timely advice on addressing *GreenComp* comprehensively and clearly in the revised, post-pilot LTPs – as well as on further enhancing the quality and teacher/student friendliness of LTP materials and how these were deployed and used in the second round of project learning events. It no small part due to PAG guidance, there are also much improved links built into TAP-TS LTPs to a greater range of age-specific teaching and learning resources, and that the materials deal with complex challenges and issues in a well thought-out and ethical way.

In summary, this section of the paper has covered how the TAP-TS Learning and Teaching Packages (LTPs) were designed to be flexible, interdisciplinary packages of curated resources and pedagogies aimed at enhancing sustainability education across Europe. Central to their design was the integration of the *GreenComp* framework, which guides the development of sustainability competencies in teachers and students through the key areas of embodying sustainability values, embrac-

cing complexity, envisioning sustainable futures, and acting for sustainability. The TAP-TS LTPs prioritise activity-based learning, drawing on constructivist principles from Piaget, Dewey, and Vygotsky, to engage learners in practical, experience-driven education. They also place a premium on opportunities for purposive reflection which is why opportunities for systematic reflection and professional learning are built into the LTP – encouraging critical thinking and personal development. Developed through a collaborative, networked process drawing on the interdisciplinary nature of the TAP-TS partnership, the LTPs were designed to be adaptable to diverse educational contexts and requirements. The involvement of a critical Advisory Board ensured the integration of current research and best practices, helping to make the TAP-TS LTPs comprehensive, user-friendly, and relevant for sustainability education across the partnership and beyond.

A final comment necessary here concerns the importance and distinctive nature of *reflection* in leading-edge EfS. While the TAP-TS approach as a partnership to the core practices of reflection for professional learning has been avowedly heterogeneous and multidisciplinary, for the purpose of TAP-TS LTPs and learning events we borrowed heavily from LfS articulation of reflection as *conversational and dialogical*. The aim of such reflection is not only to review experiences but to engage in a conversation with practice, with oneself and others. Within TAP-TS events and activities, this is done in a bounded, well-guided and ever-ambitious way. The emphasis is on working with experiences grounded in well-informed beliefs and expectations, and on appropriating or making these our own through a process of generative and dialogical negotiation. These principles become a cornerstone for the TAP-TS *MaRIA* framework, which we discuss next.

Incorporating the TAP-TS *MaRIA* framework into project learning events: adding additional opportunity for reflection on learning

Going beyond planning design: the TAP-TS *MaRIA* framework

As noted above, the TAP-TS Design Roadmap was conceived and developed to guide the processes of planning resources and materials that provide possibilities for meaningful teacher-reflection in and through education for sustainability. This is essentially *ex-ante* in its nature and purpose. Once the project moved to designing and organising learning events and actions based on the emerging LTPs it became clear that more was needed in order to move this reflection for action towards reflection-in-action and reflection-on-action (Schön, 1983). The TAP-TS *MaRIA* framework was assembled to guide and support the construction of these

innate – or in the moment – and *ex-post* opportunities for reflection; both necessary aspects of generative reflection.

Essentially, the *MaRIA* framework (Modelling and Reflecting in/on Instructional Activity) was devised to meet a project need to help participants – teacher educators, in-service teachers and student teachers – as well as other educators interested in sustainability education, with orientations for reflection about the contribution of project pedagogical proposals to teaching sustainability and to so to the development of learners' sustainability competences. As mentioned by Saari, Poulton-Busler and Vladimirova (2024), sustainability education can start with teachers within their classroom teaching contexts but poses a broader challenge that must be addressed beyond the classroom walls, encompassing both a whole-school approach and purposive community engagement. Critical discussions and reflective co-design of pedagogical experiences are essential to addressing that challenge can lead to more transformative environmental education (Saari et al., 2024). Recognising the relevance of this in the context of teacher education, the TAP-TS project put together the *MaRIA* framework, focusing teachers' reflection on three increasing open levels of engagement in sustainability education: students, school, and the community. For each level, seven dimensions of reflection were envisaged. See Figure 2 for a visual representation of this.

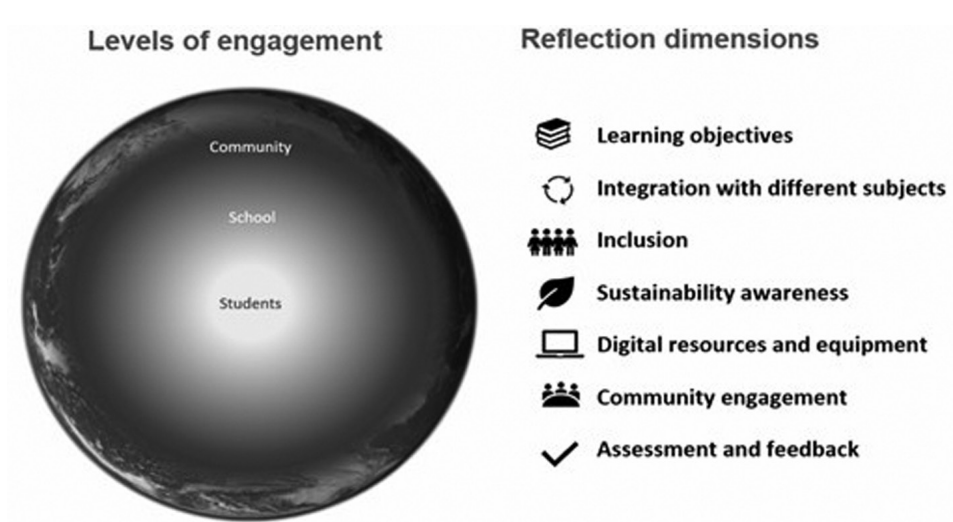


Figure 2. TAP-TS *MaRIA* levels of engagement and associated reflection dimensions.

The main elements for reflection relating to each dimension proposed by the *MaRIA* framework are detailed below:

Learning objectives. Reflection here focuses on the relation of the proposed activities with the curriculum's learning goals, their contribution to the students' overall educational goals, and their consistency with *GreenComp* standards (Bianchi et al., 2022). Researchers, such as Lovren, Maruna and Stanarevic (2020), emphasise the pedagogical value of reflections about learning objectives for sustainable development in the curricula. These reflections help to identify gaps and trends which then inform the development of targeted interventions aimed at accelerating the integration of Sustainable Development Goals (SDGs), or other sustainability goals, into educational experiences. Essentially, by reflecting on how well students grasp sustainability concepts and how they seek to apply these in real-world scenarios, teachers can ensure that the learning goals are better aligned with the broader aims of sustainability education.

Integration with different subjects. Reflection for integration can usefully focus on connections with different subjects or aspects of the curriculum covered by the planned activities. This strengthens sustainability as a cross-curricular learning area as recommended by multiple authorities in this area of learning (cf. European Commission/EACEA/Eurydice, 2024). Experiences based on the integration of sustainability into curriculum through a transdisciplinary perspective generally affirm that transdisciplinary content proposed can successfully contribute to increasing sustainability awareness at both overall and individual sustainability pillar levels (Tasdemir & Gazom, 2020). Within TAP-TS learning events, teachers' reflection about the integration of sustainability into different tasks and activities helps them to provide significant experiences to students to understand the multifaceted nature of sustainability challenges and solutions.

Inclusion. Particularly valuable here are the opportunities for in-the-moment and ex-post reflection that focuses on how the activity contributes to maximising students' participation and learning and on teachers' actions to ensure learning for all students. As stated by Medina-García, Doña-Toledo and Higuera-Rodríguez (2020), educational inclusion like any other principle or value is meaningless without action to enact and "live" it in classrooms. Teachers' reflection on inclusion and how it can be improved is crucial to better understand the concepts of inclusion and meaningful participation and how they are deeply interconnected and mutually reinforcing.

Sustainability awareness. Within TAP-TS learning events, participants are constantly led to reflect on the extent that the activities being undertaken promote sustainability awareness and responsibility. As teachers, most TAP-TS participants have a particular and specific interest in this regard. It is crucial to enhance awareness at both individual and societal levels among those we work with particularly younger generations whose present and future actions will shape the evolution

of society (Mylonas, Hofstaetter, Giannakos, Friedl, & Koulouris, 2023). Therefore, reflecting on the impact that pedagogical activities can have on their sustainability awareness, helps teacher participants to develop practices to share with students to deepen the understanding of these essential concepts and foster the importance of sustainable practices.

Digital resources and equipment. TAP-TS is not a digital pedagogies project in its core purposes. However, in terms of more meaningful learning, the project embraces the use of digital resources, materials and modalities of learning along the lines termed design resources that support reflection (Bentvelzen et al., 2022). These emphasise the value of providing opportunities for learning centring on temporal perspective, conversations, comparisons and discovery. These are woven into TAP-TS learning events in ways that encourage values and practices such as confronting ambiguity, addressing provocation, reframing narratives, and storytelling. Of course, whether the resources and equipment available in the school and classroom are sufficient to support the educational activities and how they may be used in a more meaningful way are elements of the reflection. Reflecting about the educational resources and equipment – digital or otherwise – is essential to ensure they are more effectively used to support the educational goals of sustainability. This process confirms that materials and tools – again, digital or otherwise – are enhancing students' comprehension and engagement with sustainability concepts, thereby maximising the impact of the educational experience.

Community engagement. Reflection for this dimension focuses on the extension of connections with community and other local issues related to the sustainability themes being addressed. This community-engagement element of reflection is encouraged by authors such as Saari et al. (2024) who proposed that learning for sustainability should extend far beyond schools and classrooms, reaching across sectors and disciplines to fostering diverse communities of learning and engagement. Teachers, they suggest, play a crucial role in a informing and guiding broader community of practice often initiating sustainability efforts in this context. Notwithstanding this, comprehensive support and contributions from a diverse range of actors are essential in building and sustaining such community. Similarly, Villanen (2024) also states that the relationship between social and ecological issues needs local relevance and that people need an opportunity to debate and engage with the controversial issues important to that local context. Within the TAP-TS learning ecosystem, such linkages between schools and their wider community are viewed as essential to foster deep and transformative learning for sustainability.

Assessment and feedback. Monitoring and assessing learning for sustainability can be seen as necessary but particularly challenging – in part because it needs to be applicable in more than one way. As Boud and Soler (2015) observe, a sustainable

assessment approach should meet the needs of the present in terms of the demands of formative and summative assessment but also prepares students to meet their own future learning needs. Consequently, this calls for reflection that focuses on meaningfully assessing students' knowledge and skills developed through the activities and by extension on ways of giving developmental feedback to students.

From a TAP-TS perspective, it is also important to think about gathering similar feedback *from* students so that this can inform teaching practice and resource usage. Measuring students' learning, course completion/success, community impact, state-wide goals and metrics, and SDGs accomplishment are therefore dimensions of assessment on students' sustainability learning that teachers should give attention to, as suggested by Acoba and Franco (2020). Reflecting on assessment practices ensures that teachers analyse their own practice and their contributions for students developing knowledge and the analytical skills needed to tackle sustainability challenges—as well as the developing understanding and learning of their students.

Specific examples of reflective prompts addressing the dimensions outlined above and drawn up to align with TAP-TS *MaRIA* values are included in Appendix 1. While such prompts are crucial to supporting thorough and generative reflection on sustainability education in the context of TAP-TS learning events and activities, the intensity of prompts used needed to be adjusted to better suit the interests and abilities of teachers, schools, and the broader LfS community with which we engaged.

In summary: within the TAP-TS *MaRIA* framework prompts for generative reflection on activities and interactions within project learning events emphasise particularly project concerns to enhance teaching effectiveness relating to sustainability. Participants in TAP-TS learning events are guided to assess how well the activities presented align with sustainable educational goals like critical thinking and green citizenship while ensuring interdisciplinary connections across subjects and areas of learning. Inclusivity is crucial to learning within the TAP-TS model, with prompts constantly urging consideration of equitable participation and on improving strategies to support diverse learners. TAP-TS *MaRIA* framework prompts also focus on fostering social, economic, and environmental awareness – encouraging learning event participants to do as much as possible to ensure that activities promote responsibility alongside understanding and academic content. Additionally, the effectiveness of TAP-TS LTPs in the form of its educational materials, methods, and tools is constantly examined, particularly in raising sustainability awareness. Learning event participants are prompted to evaluate where current resources are adequate and where enhancements are needed to support active and purposive learning. In many TAP-TS learning event contexts, there is also an emphasis on involving other teaching professionals and the local community in ways that connect learning to

real-world issues in sustainability and green transition. Finally, following Ruffinelli, Álvarez Valdés, & Salas Aguayo (2022), all TAP-TS learning event participants were encouraged to frame learning for sustainability experiences in terms of practical and where possible personal engagement including the construction of monitoring and assessment to better align with active-learning practices and so more wholistically evaluate student understanding. Reflection on this aspect of the project purpose was therefore especially encouraged and comprehensively inbuilt – both *ex-post* and in the moment.

What is a TAP-TS learning event?

TAP-TS professional learning events provided settings to test and validate the TAP-TS learning and teaching packages (LTPs). Eleven such events ran during Y2 and Y3: four fully on-line workshops (OLWs) each spanning about 10 days; three intensive, week-long on-site Academies – two taking place in Cyprus and one in Germany and four hybrid events termed Active Learning Events (ALEs) each run over a three-week timeframe. The TAP-TS Roadmap played a central role in the design and arrangement of all of these while the TAP-TS *MaRIA* framework was deployed during the implementation and review phases of the events to guide and inform arrangements for opportunities for professional learning through teacher-reflection. For the purposes of this present discussion, the ALE model is explored to illustrate the generative reflection opportunities built into these events, and the thinking behind these events which proved both popular and valuable within the purposes of the project.



Figure 3. Work organisation and opportunities for reflection during TAP-TS learning and teaching packages piloting.

Essentially, a TAP-TS ALE revolved around three learning moments; two online webinars and a three-day in-person moment. This is shown in Figure 3 above. The hybrid modality was chosen because it allowed for the positive impact of remote

and on-site hands-on work over time in the development of sustainability competences (cf. Olsson, Gericke, & Boeve-de Pauw, 2022; European Commission/EACEA/Eurydice, 2024). Additionally, studies, such as Douglas, Beasy, Sollis and Flies (2024), confirm the value of carefully designed mixed-mode events built around elements of sustainability education in creating real-world impacts for sustainability, student wellbeing and positive behaviour changes. Consequently, TAP-TS was determined from the outset to test-out the potential and value of well-resourced, well-designed the hybrid approaches to sustainability education.

Timeframe and activities

Each ALE opened with a real-time Ignite Webinar – this set the tone and direction of the work and introduced participants to the TAP-TS project and offered opportunities to explore the thematic resources developed as part of the project, relevant to the topic and focus of the ALE. This initial phase was crucial for laying the groundwork for the subsequent weeks, including the in-person activities sited in IPS Santarém or TU Dresden – both TAP-TS partner institutions. These online sessions in the first week allowed participants to familiarise themselves with the project's objectives and resources, ensuring they were well-prepared for the hands-on, on-site work that followed. The approach also facilitated the development of a comprehensive understanding of sustainability principles and practices, enabling participants to effectively contribute to and implement the project's goals in their respective contexts, should they choose to do so. During this first on-line week participants also engaged in online training focused on various sustainability themes, which helped provide them with a robust understanding of key environmental, social, and economic sustainability issues. Most of this activity involved reflection in the vein advocated by commentators such as Jung and Trischler (2021). Participants were given opportunities to reflect singularly and collective within the learning activities and introduced to concepts such as *reflection stages* to help structure and deepen their reflection by emphasising generative practices such as noticing, framing, acting, interpreting, and connecting.

Each ALE integrated 3-days on-site, in the company of a group of peers, for in-person work, so providing participants with a valuable opportunity to engage directly with the project themes and LTPs through dynamic and well-attended workshops, filed activities and presentations. These in-person moments were crucial for deepening participants' understanding of the LTPs and facilitating hands-on experiences with the materials and pedagogical approaches advocated. During this stage of the ALE, teacher educators, in-service teachers and student te-

achers participated in collaborative workshops where they experienced, discussed and analysed the learning activities proposed on LTPs. This collaborative environment enables participants to share insights and discuss practices, challenges and opportunities. One fundamental aspect of this stage was a workshop exploring the *MaRIA* framework itself. A significant part of this in-person week included testing of the LTP by the participants and discussions of how they might mobilise experience and confidence through these LTPs to promote practices to develop sustainability competences in their students when they returned to their home institutions.

The final week was also dedicated to online work, focusing on the consolidation and evaluation of the learning activities experiences in the in-person sessions. This included participants engaging in synchronous webinars where they presented and discussed the implementation of their developed activities. This exchange provided a platform for endorsement and constructive feedback from peers, including experienced teachers and teacher educators who offered insights and suggestions for enhancing their teaching practices. These online sessions were instrumental in helping the various LTP authors to better understand how their activities were being received and applied in different contexts. The feedback gathered was valuable for identifying strengths and areas for improvement, fostering a collaborative learning environment where best practices could be shared and refined. In the webinars, participants used a digital educational resource to reflect about their practices for teaching sustainability using the *MaRIA* framework. This reflection aimed to think how well their activities and didactic sequences aligned with sustainability education and if needed to review some activities and practices. The collaborative network fostered by TAP-TS provided participants insights and new ideas to improve their practices but also their reflection ability, ensuring that their teaching practices were more effective in developing sustainability competences among their students.

Learning events as catalysts for confidence and capability

Reflecting in and on the experiences provided by TAP-TS learning events resulted in interesting learning concerning, for example, the values of aligning LfS activities with national curricula, ensuring that they were relevant and applicable to the specific educational contexts and the possibilities resulting from engaging in reflection on TAP-TS activities and materials, including their own attitudes and possible future actions, and the value to good sustainability education of developing **self-awareness, critical-thinking, collaborative and strategic** competences (Rieckmann, 2018).

This hands-on development process allowed participants to adapt the theoretical knowledge gained into practical, actionable teaching strategies that they should apply in their educational contexts in the following weeks. The in-person work was concluded with a final reflection session, where participants revisited the activities through the lens of the TAP-TS *MaRIA* framework. This reflection helped both participants and providers assess the effectiveness of the activities and their alignment with sustainability education goals, providing an opportunity for participants to refine and improve their approaches based on feedback and insights gained during the workshops. This interactive process helped ensure that the learning activities were both impactful and integrated effectively into their teaching practices—and that there were ample and appropriate opportunities for reflection for professional learning integrated into the event and the supporting LTPs.

Evaluation methodology of TAP-TS LTPs and Learning Events

Evaluation of TAP-TS activities was led by an external evaluator. The most common approach to gathering information in TAP-TS around LTPs and Learning Events has been as follows:

Participant observation during the training event: this becomes first-hand information by forming an impression of the activities conducted within the framework of the project during the training event. This enabled an increased understanding of the activities carried out and the possibility of documenting them from different perspectives.

Based on the participant observation, focus group interviews and individual interviews in connection with the training event were conducted. Also, digital survey after each training day based on the day's content, and survey after the training event. The focus is on the following aspects of the participating teachers: 1) View of engagement and applicability of course activities; 2) Overall satisfaction with the teaching material and teaching process in five areas (engagement, participation, inclusion, applicability and competence); 3) Development of own *GreenComp* competences; 4) Development of ability to teach *GreenComp* competences in their own setting; 5) Teacher professional development in relation to *GreenComp*, for instance reflection, collaboration and networking. In addition, after each training event, an evaluation workshop was held to gather participants' thoughts, engagement, and what they have taken from the training. All participants were invited to a digital focus group interviews to discuss what they have taken from the training and applied to their organisations.

Importantly, both teacher-partners and teacher-participants in our TAP-TS learning events had defining roles in validating and finalising project outputs. The completion of LTP5 Navigating Climate Information and Disinformation offers a good example of this. Developed in close cooperation with one of the partner schools, the materials and resources were then rigorously “road tested” by teacher-participants at the Pirna Autumn School organised by the other school partner; this led to a number of significant contextual and resource adjustments that generated a stronger, more teacher-informed final product. For the TAP-TS project, this level of involvement has been extremely beneficial and well worth any extra investment of time and support required.

Towards a TAP-TS *didáctica*: the value of generative reflection for teacher professional learning

As seen above, within TAP-TS opportunities for generative reflection encourage project participants to question existing practices and explore innovative approaches to the teaching and learning of sustainability. Reflecting critically and formatively on their experiences and observations allow project participants to identify areas for attention and experiment with new techniques. The value we are finding in the TAP-TS approach to deliberately and systematically building in such opportunities and prompts for reflection includes technical value as well as enhancing professional agency – within and beyond the classroom. The previous sections detail something of the critical role TAP-TS envisions for generative reflection in adapting to the complexities and opportunities of contemporary education. This section presents our assessment of the power of generative reflective practice to cultivate a mindset of continuous improvement and creativity, essential for navigating the uncertainties and complexities of the postdigital world.

Generative reflection as an investment in better teaching

The postdigital teaching world is characterised by rapid change and unpredictability but also by an increased sense of reliability and dependability in the technologies that we use. The significance of this is well-captured by Cormier, Jandrić, Childs, Hall, White, Phipps, Truelove, Hayes and Fawns (2019) when they note the ways a postdigital perspective highlight the entanglement of the digital in social and material structures, urging a shift from novelty uses to understanding how technology shapes everyday life and the how this signifies the normalisation of digital technology in various aspects of life without fundamentally frustrating prac-

tices. In the memorable words of David White within that paper, it is when teachers spend much less time “trying to get-it-to-work than doing the work” (p. 493).

Nonetheless, teachers must be resilient and adaptable to thrive in such an environment. Generative reflection helps educators develop these qualities by encouraging them to confront challenges – learning from setbacks and continuously refining their practices. Within TAP-TS we have found that the reflective process builds confidence and equips teachers with the skills needed to navigate and adapt to future disruptions. Where we see the generative reflective processes embedded in TAP-TS offering particular value is in the ways they foreground and help cultivate dispositions, attitudes, and beliefs of imminent use in this fast-changing world.

The approach adopted within TAP-TS to advance this agenda has been discussed above. Building on these earlier discussions and examples, we can now offer a number of observations on the value and power of generative reflective practice for professional learning. First, the practice at the heart of the TAP-TS project goes beyond mere knowledge acquisition. It deepens the learning process by encouraging participants to engage with the personal and instructional experiences of sustainability, fostering both professional and personal development and technical understanding. This approach helps participants internalise sustainability values and build confidence and capability to apply them in learning and teaching contexts. Second, the pedagogic modelling embedded in TAP-TS draws from an interdisciplinary framework and concomitant view of professional learning. By providing opportunities and materials that promote collaboration between teachers and learners in ways that emphasise diverse perspectives and take insights from different disciplines, the academy ensures that participants develop a more holistic understanding of complex sustainability and just transition issues thus enhancing their ability to address these challenges more effectively in teaching and learning contexts. The flexible and adaptable nature of the reflective practice frameworks in the TAP-TS project empowers participants with the technical and didactic capabilities to better shape learning materials and activities to their own specific teaching settings. This adaptability ensures that the learning experiences participants go on to provide for their own students are similarly generative and life-informing. Third, reflective practice in the generative mode embraced by TAP-TS is not just a clinical exercise in planning for and reviewing teaching. As we have seen, both the Roadmap and the *MaRIA* framework emphasise criticality and the centrality of engaging closely and sincerely with the tasks of envisioning sustainable futures. This future-oriented reflection encourages academy participants to think critically about their actions and their impact on sustainability, as well as the institutional and systemic barriers and opportunities that teachers need to be aware of and engage. We believe that this informs and drives more proactive and better-informed

decision-making and rehearses in a didactically meaningful way the fundamental *GreenComp* rationale of embodying sustainability values, embracing complexity, envisioning sustainable futures, and acting for sustainability (Bianchi et al., 2022).

Generative reflection as an act of agency with inherently professional value

The earlier discussions of generative reflection stages and design resources that support reflection raise some interesting propositions for teacher agency and the teaching of sustainability as an affirming, agentic action. Within the TAP-TS partnership, there is strong support for the idea of life-course agency advanced by Eteläpelto et al. (2013) with its subject-centred socio-cultural perspective and attendant propositions relating to professional agency as the ability of individuals and communities to influence, make choices, and take stances in their work and professional identities. This work presents agency as something both individual and collective – for Eteläpelto et al. (2013) individual agency and the social contexts of collective agency are seen to be analytically separate but mutually constitutive and in complex ways highly interdependent. They put forward seven propositions based in this understanding. While we have found all of these propositions to be persuasive and helpful in our thinking regarding agency and agentic action within TAP-TS, two in particular would have relevance here: “(iii) The practice of professional agency is closely intertwined with professional subjects’ work-related identities comprising their professional and ethical commitments, ideals, motivations, interests, and goals,” and “(vii) Professional agency is needed especially for developing one’s work and work communities, and for taking creative initiatives. It is also needed for professional learning and for the renegotiation of work-related identities in (changing) work practices” (Eteläpelto et al., 2013, p. 62).

The value of the former can be seen in the earlier discussions of the TAP-TS Roadmap. As noted then, six flexible steps (areas) underpin the production of LTPs and are based in key principles for teaching sustainability and a number of tried and tested pedagogical approaches to support this. Also as noted, the TAP-TS Roadmap is informed by current research and practice in Education for Sustainability and firmly-based within the EU *GreenComp* framework. What may be less obvious is that it represents deliberation and an extensive exercise in co-design and co-development set against the team’s belief that promoting professional agency is an essential aspect of teacher education fit for purpose in the emerging European Education Area context.

The Roadmap represents TAP-TS’s best-possible articulation of a journey to embed and leverage opportunities for generative reflection within project materials and activities in ways that encourage teachers to share their insights and

experiences with colleagues and so foster a culture of collective learning and improvement. Collaborative approaches lead more assuredly to the development of shared practices and innovative solutions, benefiting the entire educational community involved. The Roadmap reflects this in the ways it positions opportunities for continuous, dynamic learning processes which prompt learners to engage deeply with their experiences and insights, and so encourages pedagogical and didactic action that fosters growth and innovative thinking. This, we suggest, fosters an agentic identity among project participants centred on cultivating the personal and collective educational dispositions, attitudes, and beliefs dialogically positioned at the heart of the TAP-TS mission.

The principles articulated in Eteläpelto et al.'s (2013) proposal relating to the value of engaging professional agency to develop one's work and work communities and for taking creative initiatives were also profoundly significant in framing the TAP-TP way. We see this particularly in relation to the inclusion of generative reflection opportunities within various *MaRIA* framework activities through the use of reflective stages and HCI design resources. Section 2 above provides discussion and multiple examples of this. In summary, the TAP-TS *MaRIA* framework aligns well with the stages approach identified by Jung and Trischler (2021) – especially in the ways that *MaRIA*-led reflection encourage and emphasise **noticing** and **focusing** as the start of generative professional learning and **interpreting**, **continuing** and **connection** at the later stages. Of course, the contextual advantages of a fully stages-driven model are not possible to replicate in full within every reflective encounter presented by TAPS LTPs. We are confident however that what has been achieved reflects well on efforts to always push participants towards professional learning and agency through generative reflection and dialogical engagement. As Jung and Trischler (2021) note, agency is a powerful force for worldly re-configurations, for building agential capacities through learning and doing, and for developing professional capability in relation to what they term **agential cuts** (p. 559) – a rather lovely expression for making selections and engaging with practices that produce ongoing re-configurations in the practice setting.

For the articulation of a project *didáctica*, TAP-TS focused on fostering life-course agency through a vision of professional agency and agentic action that is fundamentally oppositional to the ethico-political construct of “agency” promulgated by the OECD and similar econometric-determined policy actors – with its intentions towards “...including the relational and dynamic relationships between agency (people), structure (things), and culture (parts)” (Bryan et al., 2024, p. 349). As illustrated above, our framing has been intentionally critically-oriented and generative. It remains far from perfect but represents an advance in discursive and professional-practice terms that is necessary and timely.

Generative reflection as a learning horizon event

Looking beyond the classroom is one of the key principles of teaching sustainability. Indeed, if Education for Sustainability requires an action-oriented and transformative pedagogy (Rieckmann, 2022), experiences that help learners become aware of and critically reflect on their assumptions as well as lead to “conceptual change” and concerted action are needed. These should go beyond the classroom. Drawing on the *GreenComp* framework, an important part of sustainability competences is to be able to identify one’s potential for sustainability, and to actively contribute to improving prospects for the community and the planet (Bianchi et al., 2022). This includes not only knowledge about the community organisation, how and whom to contact but also related skills and attitudes. Just as the materials and pedagogical activities aimed to address the need to build a vision for a more sustainable community life and to act accordingly, we attempt to be more ambitious and go beyond reflection on the classroom experiences alone.

In section 2 we presented how we structured *MaRIA* around three levels of engagement: students, school, and the community, as well the one particular dimension that refers to purposive Community Engagement. With this we hope to build capacity for appreciation of the world and its connectedness, as well as a sense of responsibility and agency toward sustaining community well-being. The process engages in reflection on the uses of technology and TAP-TS activities and materials, but also around attitudes and possible actions, and aims to develop self-awareness, critical-thinking, collaborative and strategic competences (Rieckmann, 2018). The reflective process in this case may, firstly, include reflective observation assisting students and teachers make meaning of the world around them and strengthen the process of understanding the complexities and interconnectedness of social and environmental systems; secondly, critical questioning that stimulates deep reflection, and help to understand more deeply the world around us with all its complexity, and what tools and activities can assist in this; and, thirdly, questions that invite to act rather than react to build a collective capacity necessary to be able to meet sustainability challenges.

In TAP-TS learning experiences, such reflective processes may follow collaborative real-world (school and community related) projects, vision-building exercises, stakeholder analysis, modelling games, community-based research etc., also inviting individual and collective action. Importantly, opportunities for reflection are deliberately structured to be generative and the learning experiences themselves are thought of as collaborative, co-designing processes which foster participatory learning and critical thinking, and thus motivate and enhance ability to take part in making a positive contribution to the community, and the planet.

Closing Comments

As stated at the opening, this paper is structured as an account of our experiences designing-for and building-in opportunities for systematic, generatively reflective and dialogical teacher learning within TAP-TS project actions and resources. It represents part of the project team's ongoing collective attention to articulating and sharing the learning that emerged through designing, developing, in-context testing, and user validation the TAP-TS LTPs as key project outputs. As such, this is very much work in progress and as authors who are part of a wider and still-on-going venture we acknowledge both the tentative nature of parts of what we have presented, and any incomplete detailing involved.

Sharing work in progress sits easily with the ethos and practices of the TAP-TS partnership. Early rehearsal helps identify issues and refine ideas, leading to more thoughtful and informed conversations among the teacher education and policy communities to which we belong. Additionally, within TAP-TS we have found that sharing encourages further learning and collaboration, allowing for the uncovering of further perspectives and ultimately enhancing the overall quality and creativity of the work we are doing.

A final thought: TAP-TS is a teacher education and development at its core not an education technology or materials development project but much of what we do is premised on better and more generative reflection on the uses of our project outputs and the learning and teaching technologies within the *didáctica* that we employ in our professional learning activities and LTPs. In and through the reflection work enabled by these materials and associated pedagogical activities we push the learning horizon and, to borrow from emerging discourse around collective intelligence and the common good, seek to more effectively **socialise the gains** (Mazzucato, 2024) for teachers engaging with the project for their professional learning and development. This quest for criticality, agency, and identity is – as noted at the outset – a *leitmotif* of TAP-TS LTPs and indeed of the project in general. TAP-TS as an inaugural Erasmus+ Teacher Academy would aver without reservation that teacher reflection of a strongly generative and dialogical nature holds considerable potential for professional growth and particular relevance for the times in which we live. It deserves to be more widely discussed and employed.

Continuities and possible futures

TAP-TS partners have undertaken a significant number of actions to advance the project's work and maximise its benefits. Successful experience with LTPs has

driven substantial programme development among the teacher education partners, with substantive new modules and seminars being added to partners' teacher education programmes. Indeed, all five teacher education partners have planned extension and continuation work related to project LTPs and resources. At UCD Dublin, two credit-bearing modules – *Understanding & Teaching Sustainability* and *Climate Action and Sustainable Development* – have been integrated into its initial teacher education programme. PHW Vienna uses TAP-TS materials in hands-on, transdisciplinary workshops and plans to incorporate these resources into three key courses; *European Union Studies*; *Digitale Grundbildung*; and *Hochschullehrgang Ethik* programmes. TU Darmstadt's teacher education programme now includes a module on *Bildung zur verantwortungsbewussten Digitalisierung* – developed using TAP-TS's approach and co-creative methods for developing reflexive pedagogical materials. In Portugal, Politecnico De Santarem embeds multiple LTP units like *Actions to Protect Energy* and *Actions to Protect Biodiversity* in its ITE seminar programme – and plans to expand this to a transnational offering in the coming year in collaboration with PHW Vienna. TU Dresden has expanded its formal course offerings in sustainability education by creating a certificate programme in *Education for Sustainability* for student teachers and also integrating TAP-TS resources into workshops for serving teachers. Additionally, TAP-TS resources will be used in the future to support international teacher education courses offered through TU ZLSB – which has led to an international capacity-building project with universities in Mozambique and Uganda, launching in 2025. Another particularly pleasing TAP-TS development has seen FSG Pirna, a TAP-TS school partner, initiated an exciting bilateral teacher mobility project inspired by its participation in the TAP-TS Autumn Academy and involving contacts made at this event. Furthermore, TAP-TS consortium members have contributed to a number of significant and influential policy events including the European Education Area mid-term review and the inaugural Erasmus+ Teacher Academies Learning Event in spring 2024. They have also spoken and presented at multiple education conferences – such as ECER2024 and ATEE2024.

These are some examples from among many of the ways that TAP-TS has opened up possibilities for continuing and future work. Additionally, at the consortium level, most of the partners continue to work together on further funding bids and applications – both at EU and bilateral levels. In terms of contributing to advancing the European Education Area agenda, this is important as it continues core features of TAP-TS efforts – actively working for better connected teacher education and development provision across Europe, and exploring the complex relationships between mobility, high-quality teacher-relevant provision and professional learning.

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Appendix 1. Levels and dimensions of reflection in the TAP-TS *MaRIA* framework

Prompts for reflection on the student experience	In what ways do these activities contribute to the global educational goals for your students? In what ways do the activities engage your students with different knowledge areas and subjects of the curriculum? In what ways can these activities be connected with different subjects/ areas of the curriculum? In what ways the activities could engage your students with different knowledge areas and subjects of the curriculum? In what ways these activities could be connected with different subjects of the curriculum? Can the previous activities contribute to all students' participation and learning? What actions can you take to ensure the learning of all students? To what extent do the activities promote awareness and responsibility among your students? Did the implemented educational materials, methods or tools increase or rather limit the opportunity to increase students' environmental awareness? Do the current resources and equipment available in your institution adequately support the activities you have selected and implemented from LTP materials, or are there enhancements needed? To what extent can you involve the local community or connect with community issues related to the sustainability theme approached? Can you adapt the assessment methods or the requirements for students after integrating the educational materials, methods, or tools into your existing teaching concept? If yes, in which way/how?
Prompts for reflection on school and school community engagement	Within the school or learning context, how have the activities helped the learners in terms of embodying sustainability values, acting for a sustainable future and/or envisioning a more sustainable future? How have the activities contributed to collaboration with others at school or institutional level to approach a sustainability issue from different perspectives, knowledge areas and contexts? Do the educational materials, tools and methods you have implemented also offer potential for use in other subjects? If so, in which subjects? How have the activities contributed to engage with different perspectives to consider sustainability challenges and opportunities? How have the activities encouraged the students to be aware of their individual and collective impact on nature, and provided opportunities to restore it at school level? How did you try to enable students to use resources for learning at school in a sustainable way? Have the selected and implemented educational methods, tools and materials encouraged you to initiate cooperation with external partners (associations, companies, NGOs, etc.) to enrich learning experiences? If so, in which areas are you aiming for cooperation? To what extent does your teaching practice encourage students to use evidence, combine knowledge and resources to analyse and evaluate futures and their opportunities, limitations and risks, and contribute to decision-making at school level?

Prompts for reflection on wider community and societal engagement	How have the activities added to the knowledge and understanding of the learners in terms of working with others in the broader community to create inclusive visions for a more sustainable future? How have the activities encouraged students to draw on different perspectives, and subject knowledge to identify interconnections, and reflect on one's own environmental, cultural and economic impact? How do the activities help reflect on, identify, envision or even shape the trajectory towards a collective preferred future that includes various perspectives, cultures, traditions, and are grounded in values for sustainability? How have the activities contributed to grasp connections and interactions between natural events and human actions? Did the activities encourage students to assess and question their needs to carefully manage resources in the pursuit of longer-term goals and common interests? How did the activities help them to think critically about information sources and communication channels on sustainability to assess the quality of the information they provide? To what extent do the activities engage in democratic decision making and civic activities for sustainable development? How does your teacher practice encourage students' intentions and willingness to give back to the community and nature? To what extent does your teaching practice encourage students to use evidence, combine knowledge and resources to analyse and evaluate futures and their opportunities, limitations and risks, and contribute to decision-making, and become agents of change?
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